Department of
Agriculture

Forest Service

May 1996

Forestry Research West

A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture

Forestry Research West

In This Issue

Cover

Research Forester Jack Schmidt examines the year's growth on a Japanese larch tree planted in the International Larch Arboretum at Hungry Horse, where most of the world's species of larch are planted. Scientists are concerned about the tree's survival, and are studying various silvicultural and other methods with hope of securing it's future. Read about it on page 13.

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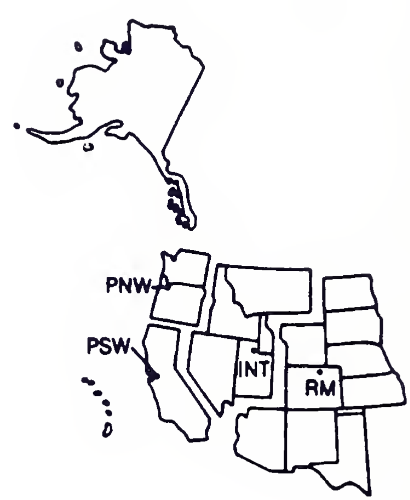


Timber-dependent communities: fact or fiction?

by Jennifer Gomoll
and Sherri Richardson
Pacific Northwest
Station

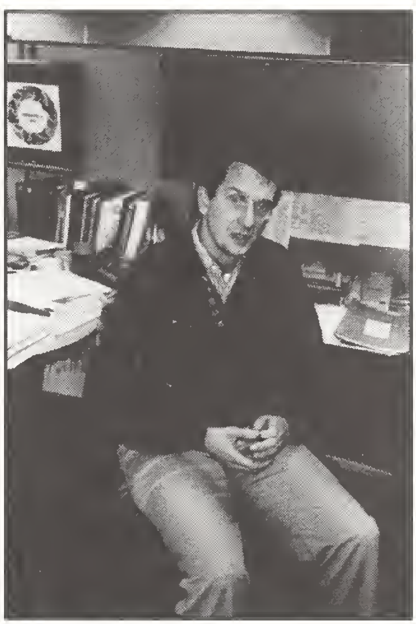
The reduction in Federal timber harvests has been in the news for several years. Stories have featured "timber-dependent communities"—communities perceived to be severely impacted by legislation that limits the amount of timber that may be cut on public and private land. The fear was that sawmill closures would put hundreds of people out of work. An assumption has been that associated commmunities might not be able to recover from the devastation of timber cutbacks.

Recent research by the Interior Columbia Basin Ecosystem Management Project shows that this assumption may be a misconception. Many people have suffered, and the transition these communities have been forced to face has not been easy. The research, which focused on the social and economic resiliency within the Interior Columbia River Basin, shows that many of these communities survive, even flourish, much better than was once thought.

"We're trying to get away from terms like timber-dependent and commodity-dependent because communities are more complicated than that," said Richard Haynes, Research Team Leader. "People tend to see a mill closing and all the possible devastation associated with the closure but what they don't see is the hundreds of people who work in the local hospital or the accountants—all the underlying services of the community. This is what we're trying to emphasize—the communities as an economic whole."

Background

The Interior Columbia Basin Ecosystem Management Project was established through the joint effort of the Forest Service and the Bureau of Land Management. This was in response to President Clinton's plan for ecosystem management in the Pacific Northwest. Clinton directed the Forest Service to "develop a scientifically sound and ecosystem-based strategy for management of Eastside forests." The process links landscape, aquatic, terrestrial, social, and economic characterizations to describe the biophysical and social systems. This resiliency research was done by the Social and Economic Team of the project. The team included social scientists, Steve McCool, Jim Birchfield, and Stewart Allen; and economists, Richard Haynes, Amy Horne, and Nick Reyna.



Richard Haynes discusses the research results on timber communities.

The basin

The basin area includes 100 counties in Oregon, Washington, Idaho, and Montana. Throughout this vast area, many different climates, topographies, cultures, and land uses exist. Agriculture, forestry, and agricultural services make up their main economy. Recreation is also a very important aspect of the basin's economy.

There are 476 communities of less than 10,000 people in the basin and only six urban areas (Spokane, Yakima, Benton, and Franklin counties in Washington; and, Ada and Canyon counties in Idaho). It is one of the most rural regions in the Nation. The population per square mile in the basin is one-third the national average. The economies are mixed and their vitality is linked to factors other than commodity production.

Seventeen counties in the basin are considered recreation counties because they attract

migrants, many of whom are entrepreneurs and retirees looking for a relaxed and aesthetically pleasing place to live. The population has been growing steadily since 1990 in 96 percent of the basin counties with most of the growth occurring in the urban and recreation counties. It is expected that the primary driver of the basin's economy in the future will be population growth. The fastest growing economic sectors are services, trade, finance, insurance, real estate, and transportation.

Currently the basin is enjoying robust economic growth. In terms of employment, agriculture and agricultural services dominate the basin's economy. And 15 percent of the basin's employment is attributable to recreation. The National Forests and Bureau of Land Management lands in the area provide the most dominant source of recreation. Because most usage of public lands is free of charge, income generated from the use of these public lands is generally not earned by the Forest Service or Bureau of Land Management, rather it is the private sector services in the area that benefit economically—the restaurants, motels, outfitting suppliers, equipment rentals, and so forth.

Social and economic resiliency

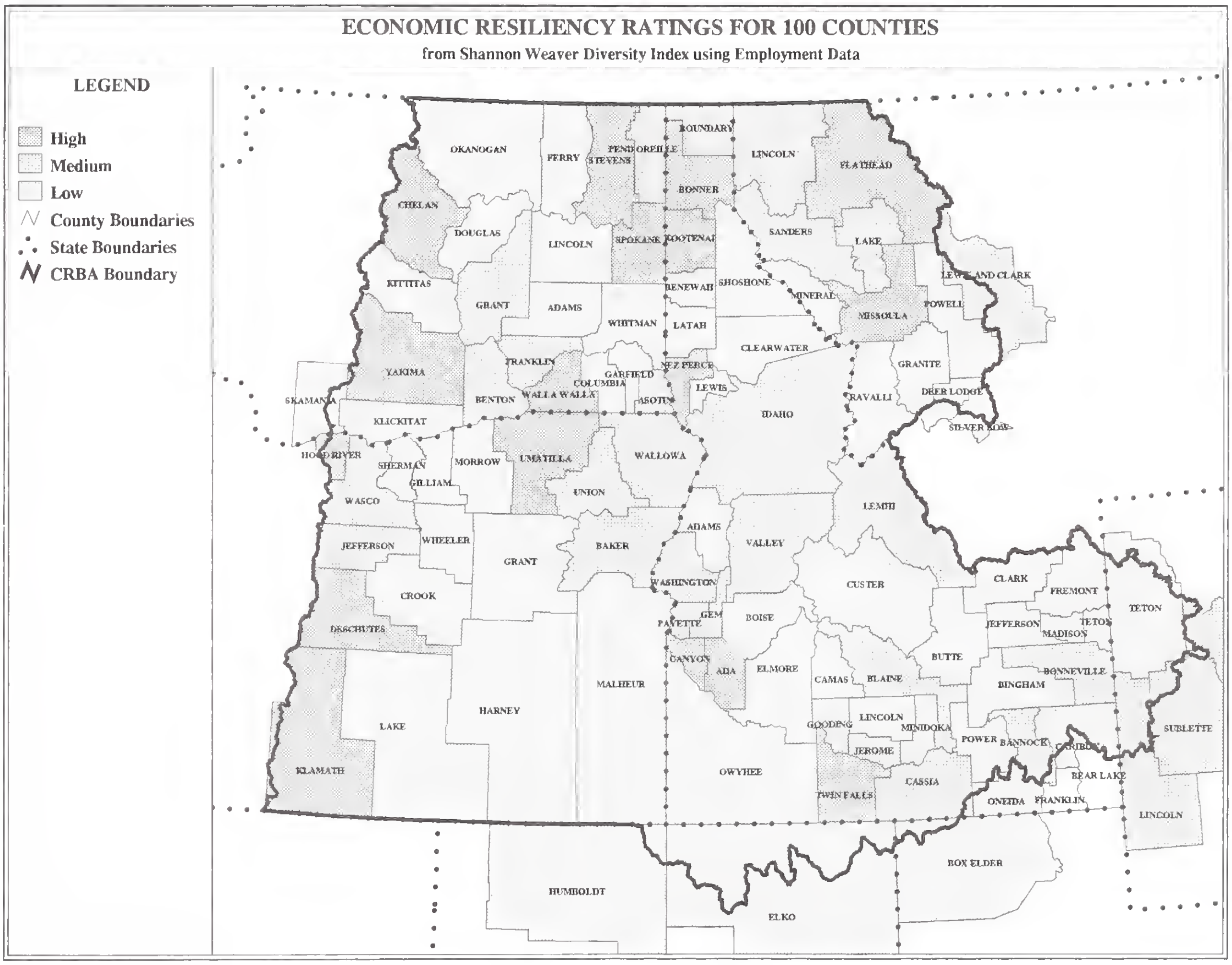
Social and economic resiliency in the context of ecosystem management reflects the interests of people to maintain well being through personal and community transitions. Economic resiliency is correlated with diversity among employment sectors, such that people have ready access to a range of employment opportunities if specific firms or business sectors experience downturns.

Social resiliency incorporates economic resiliency but also includes measures of human initiative and organization; attributes such as cohesion, cultural diversity, and leadership are taken into account. In this study, research was done at the community level and was based on the following composite factors:

- civic infrastructure (leadership, preparedness for change)
- economic diversity
- social and cultural diversity (population size; mix of skills)
- amenity infrastructure (attractiveness of the community and surrounding area)

Because resiliency attempts to measure response, classifications of social resiliency serve as relative estimates rather than absolute descriptions. Social resiliency is the ability of people within a community to adapt to changes—personally and at the community level.

There are many recreational opportunities in the Columbia River Basin.



Therefore, the larger the population, the more resources it has available and the higher the resiliency.

Economic resiliency

The economic resiliency in the basin was measured with the Shannon-Weaver Index which is a biological index that measures diversity. Diversity indexes were computed from the number of different industries in the given areas. Data are shown below for the Bureau of Economic Analysis (BEA) areas. These areas are multicounty regions named for the largest community included.

BEA area	*Diversity Index*
Boise	.94
Butte	.88
Idaho Falls	.92
Missoula	.92
Pendleton	.91
Redmone-Bend	.92
Spokane	.94
Tri-Cities	.92
Twin Falls	.91

The highest possible score on the index is 1.0 indicating the economies within the basin are diverse and consequently have high economic resiliency. Unemployment rates do not enter this index, but they are lower than the national average. Because the basin area is very rural, several neighboring counties are combined before one area becomes economically whole. Counties in this rural area are not economically whole and individually their economic resiliency is lower on the index. This explains the wide variance from the resilience ratings of the BEA areas (multi-county) being so much higher than that of the individual counties shown on the map of the basin area. In 1987, 66 communities in the basin were officially classified as "timber-dependent." There are only 22 communities that still hold this classification. Most of these communities are very rural and off the main highways. These "timber-dependent" communities are still fairly healthy economically. The most fragile of the basin communities are the areas that rely most heavily on agriculture. These areas are also the most rural and lack access to the services that more urban areas provide. The high fluctuation of prices of agricultural products also lends to less economic resiliency in these communities.

Conclusion

In examining community-level changes in the basin, those communities that have been confronted with significant challenges—such as sawmill closures—are among the most resilient because they have successfully learned how to deal with change. Adversity, although painful and not without casualties, provides incentive for social interaction and cooperation, catalyzing organization and forward-directed actions. The power of people to persevere, even under the harshest conditions, is a legacy of the human experience," said Haynes. Communities that have experienced, what may seem to be fatal blows, such as the closing of mines in Wallace, Idaho, have continued to carry on based on a reorientation to new economic activities.

For more information about Social and Economic Resiliency or the Interior Columbia Basin Ecosystem Management Project, contact Richard Haynes, Portland Forestry Sciences Laboratory, PO Box 3890, Portland, OR 97208.

Research in urban forestry

by Dr. Greg McPherson
Pacific Southwest
Station

They are small pockets of green in an otherwise concrete landscape. They are islands of life and beauty tucked between suburban development and busy streets. They are small enclaves of serenity in a bustling world of business and traffic. They are our urban forests.

By the year 2000 approximately 80% of the country's population will live in urban areas. Each year thousands of acres of rural land become urbanized. As rural land is converted to urban uses, it becomes increasingly important to consider and understand the ecosystems that can thrive in our rapidly urbanizing landscapes.

Role of urban forests in cities

With proper management and care, urban forests can contribute tremendously to the economic vitality and the quality of life in cities. Physical benefits of these ecosystems include cleaner air, cooler cities during summer, better human health, reduced energy and water consumption, and more wildlife habitat within cities. Healthy urban forests help cities attract and retain businesses, increase property values, and enhance community attractiveness. As cities grow to maintain vigorous local economies, urban forests can mitigate some environmental impacts of development and enhance quality of life.

A dense forest canopy acts like a screen, filtering out air pollutants, and reducing solar radiation reaching city inhabitants. Tree shade reduces the higher temperatures associated with city environments, a phenomenon known as the Urban Heat Island Effect. Forest Service research indicates that a healthy urban forest can lower the average city temperature by 2-8 degrees F° on a hot summer day. Trees planted strategically around buildings reduce the amount of air conditioning required in the summer. Reduced air conditioning means less energy is consumed, which saves money, and lowers carbon dioxide emissions associated with energy production. Because trees utilize carbon dioxide in photosynthesis, they are carbon sinks— removing carbon dioxide from the atmosphere. Thus, urban forest management is one means of reducing heat-holding atmospheric carbon dioxide, thereby reducing the potential adverse impacts associated with global climate change.

Crisis

Given the virtues of an urban forest, one might think that such ecosystems are carefully protected. But in the last several years, shrinking municipal budgets have produced a crisis for our nation's urban forests.

Downsizing of local governments has led to drastic cuts in spending for urban forest management. These cuts reduced the ability of urban foresters to care for urban trees, particularly to maintain adequate inspection and pruning schedules, and to guard against pests and diseases.

Response

The response to this urban crisis was a paradigm shift in urban forest management. Traditionally, city trees were managed and maintained by city governments, often through a specialized tree division. With the recent wave of budget cuts to such departments, responsibility for some urban forests shifted towards non-profit organizations. Community service groups, such as the Sacramento Tree Foundation, are instrumental in raising public awareness of, and involvement in, urban forests. The Sacramento Tree Foundation shows residents how to plant and maintain trees, and teaches them about early diagnoses and treatment for common tree diseases. They create partnerships with the business community, enlisting their support for urban forestry. Absolutely critical to this community forestry effort is the role of scientific research.

Research

Forest Service research provides three essential elements to today's urban forests. First, it provides benefit-cost information

to potential investors, allowing them to evaluate their return on urban forest investments. This has, for instance, been critical to developing the active partnership between the Sacramento Tree Foundation and the Sacramento Municipal Utilities District. Since its inception in 1990, their joint program called Sacramento Shade is responsible for planting nearly 200,000 trees to reduce the demand for residential air conditioning.

Research provides information to municipal urban forest managers that helps them use limited resources more efficiently. Faced with shrinking budgets, most city Tree Divisions are trying to do more with less. For instance, current Forest Service research is examining the cost-effectiveness of different mitigation measures for the ubiquitous and costly problem of sidewalk damage caused by tree roots. Such information will allow forest managers to optimize their use of dwindling funds.

And finally, research has been vital to public education efforts designed to increase public understanding of, and appreciation for, the multiple benefits of urban forests. An informed citizenry will recognize the wide-ranging benefits of these systems, providing grass-roots support for their care and management. For this reason, research has provided the critical scientific underpinnings behind the growth of non-profit sector involvement in urban forest issues.

Conclusion

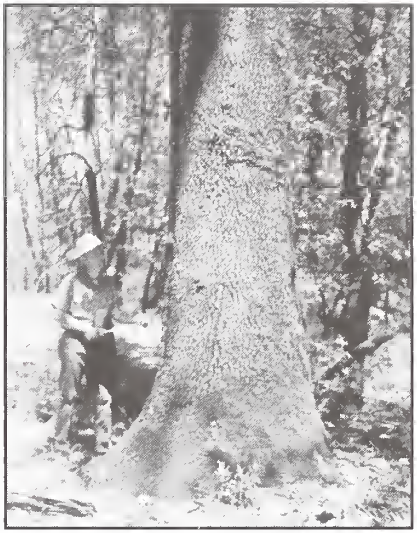
Despite the tremendous range of benefits stemming from our nation's urban forests, these urban ecosystems are in peril. Shrinking budgets reduce the ability of urban forest managers to effectively protect these resources. Science by Forest Service researchers is answering emerging questions on the structure and function of these vital systems. In partnership with local industry and non-profit organizations, government is making a critical contribution to maintaining the health of urban forests and the quality of life in cities for all of us.

For further information on this subject, refer to the Northeastern Experiment Station's General Technical Report NE-186, titled *Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project,* Pacific Southwest Research Station (916-752-5897); Rowan Rowntree, research forester (forests and urbanization), Pacific Southwest Research Station (510-559-6491); and Dave Nowak, research forester (forest structure and air quality), Northeastern Forest Experiment Station (315-448-3212).

California's hardwood resource

by Philip M. McDonald
and Dean W. Huber
Pacific Southwest
Station

California's economically promising forest-zone hardwoods can be found from the Oregon state line almost to the Mexican border, and from near the Pacific Ocean to the Nevada state line. Within California, they grow well to an elevation of about 7,500 feet, and form many ecological types as pure hardwood stands, as components of mixed hardwood and conifer stands, and as occasional trees, clumps, and groves within the conifer forest. Stands of hardwoods are usually scattered across the landscape and seldom occupy extensive areas. As broad sclerophylls, the hardwoods have developed a host of physiological and morphological adaptations that have allowed them to compete, prosper, and reproduce their kind for millennia.



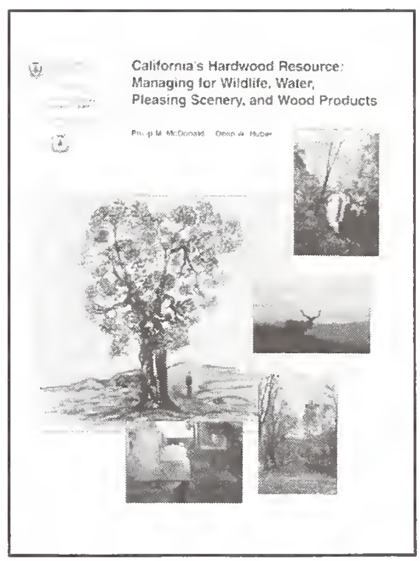
A mature black oak in the Shasta-Trinity National Forests, California.

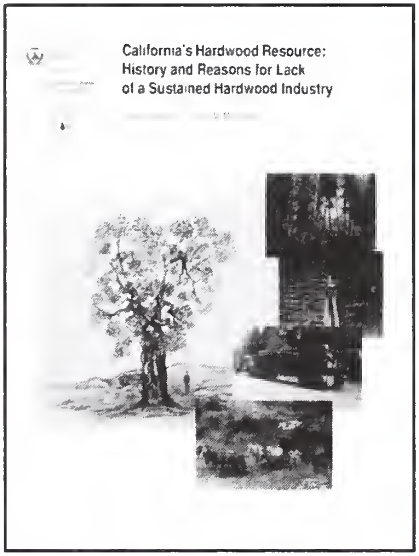
Hardwoods "home" to many

As a resource, the inventory of hardwood trees is huge, contains every size class and structure possible, and currently has a net increase as burgeoning hardwood sprouts capture cut-over land formerly occupied by conifers. There is even a high proportion of old-growth trees. More than 300 species of birds and animals call the hardwood ecosystems "home." Many people enjoy the contrast and beauty of the hardwoods in spring and fall, and many acre-feet of water come from the hardwood forest. In terms of the total potential worth of amenities and commodities on public land, the near-term value of hardwoods is manifest in wildlife, water, pleasing scenery, and wood products. On private land, the need to supply an ever-increasing amount of wood products could mandate that wood fiber be the primary yield. Water could well be a commodity of great worth in California in the near future on both ownerships. For public and private land, management is not limited by gaps in the resource base; rather it is challenged by the enormity of it all.

The forest-zone hardwood ecosystems in California are variable, widespread, and highly complex. Managing these ecosystems for sustainable yields and values brings concerns for the land and for human beings together. People and their effect on the land are an integral part of ecosystem management.

The art of silviculture has a bright future on both public and private land. Ecological types, or habitats in the case of wildlife, will need to be maintained, prolonged, and created. It will be silviculturists who will do this over a broad range of space/time scales. To achieve both ecological diversity and rural community stability, silviculturists will manipulate individual species on small plots of land for a short time and sustain complex plant and animal communities over 100,000-or-more-acre landscapes in perpetuity. They also will intensively manipulate hardwood stands to achieve





spacing and density levels that will yield optimum levels of wood fiber and water. The wood has value that is maximized when processed into useful products. A stable and dynamic wood products industry is a critical adjunct to silviculture, which in turn is a critical part of ecosystem management.

Varied yields

Each yield has value individually. For wildlife, the greatest value of the hardwoods is the acorns and berries that they produce. The frequency and magnitude of acorn crops, for example, is critical to fawn survival rates and ultimately to the size of the deer population. For water, deciduous hardwoods use 20 to 30 percent less water than evergreen conifers, and manipulating hardwoods to enhance streamflow has much promise. For pleasing scenery, the vivid and contrasting spring and fall color of hardwoods is without peer. For timber and wood products, the potential uses are numerous. With proper treatment, hardwoods can be manufactured into specialized and traditional products such as toy blocks and odor-free food storage cabinets as well as into classic lumber products and veneers.

For multiple yields, hardwoods can achieve their true potential as producers when some key factors, such as teamwork, scheduling, social aspects, and total yield, are addressed. Future management of the vast hardwood resource is too much for one person, and innovative teams of scientists, managers, and other stakeholders must be formed to formulate policy and solve problems. Ecological risk taking and flexibility will be keys. Scheduling is extremely important for managing the hardwoods, because it permits field jobs, raw materials, manufacturing and service jobs, and products and amenities flow from the land in a predictable manner for the benefit of all. The variable nature and extent of the hardwood resource allows it to serve people as individuals in towns and small cities in rural America. Special "forests" in urbanized and agricultural settings can serve America as well. Once all the goods and services that come from the hardwood resource are given a realistic value, below-cost timber sales and most amenity enhancements, which also rarely pay their way, will be a thing of the past.

Hardwood forests provide habitat for a wide variety of wildlife.

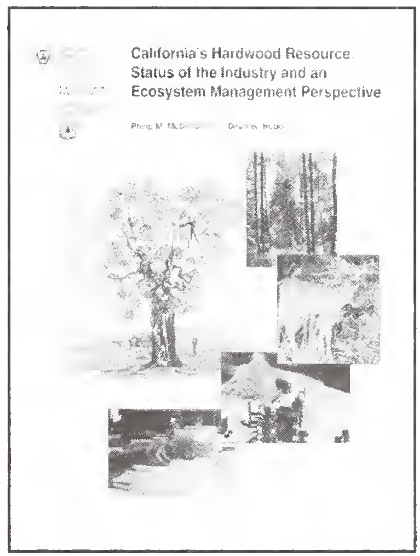
Big is better

Opportunities abound for managing hardwoods for multiple yields. In general, good wildlife management is good timber management as well as good management for esthetics and water. It cannot be emphasized enough that the total worth of carefully grown forest hardwoods, particularly if deciduous, is maximized with large trees.

Typical leaves, twig and acorns from California black oak.

Philip M. McDonald is a research forester assigned to the Pacific Southwest Research Station, studying the regeneration of California forests, with headquarters at 2400 Washington Avenue, Redding, CA 96001. Dean W. Huber is a forest products technologist, State and Private Forestry Staff, Pacific Southwest Region, USDA Forest Service, 630 Sansome Street, San Francisco, CA 94111, specializing in utilization, marketing, and recycling of wood products.

For further information on this subject order *California's Hardwood Resource: Managing for Wildlife, Water, Pleasing Scenery, and Wood Products*, General Technical Report PSW-154. Also available are companion reports: *California's Hardwood Resource: History and Reasons for Lack of a Sustained Hardwood Industry*, General Technical Report PSW-135; and *California's Hardwood Resource: Status of the Industry and an Ecosystem Management Perspective*, General Technical Report PSW-153.



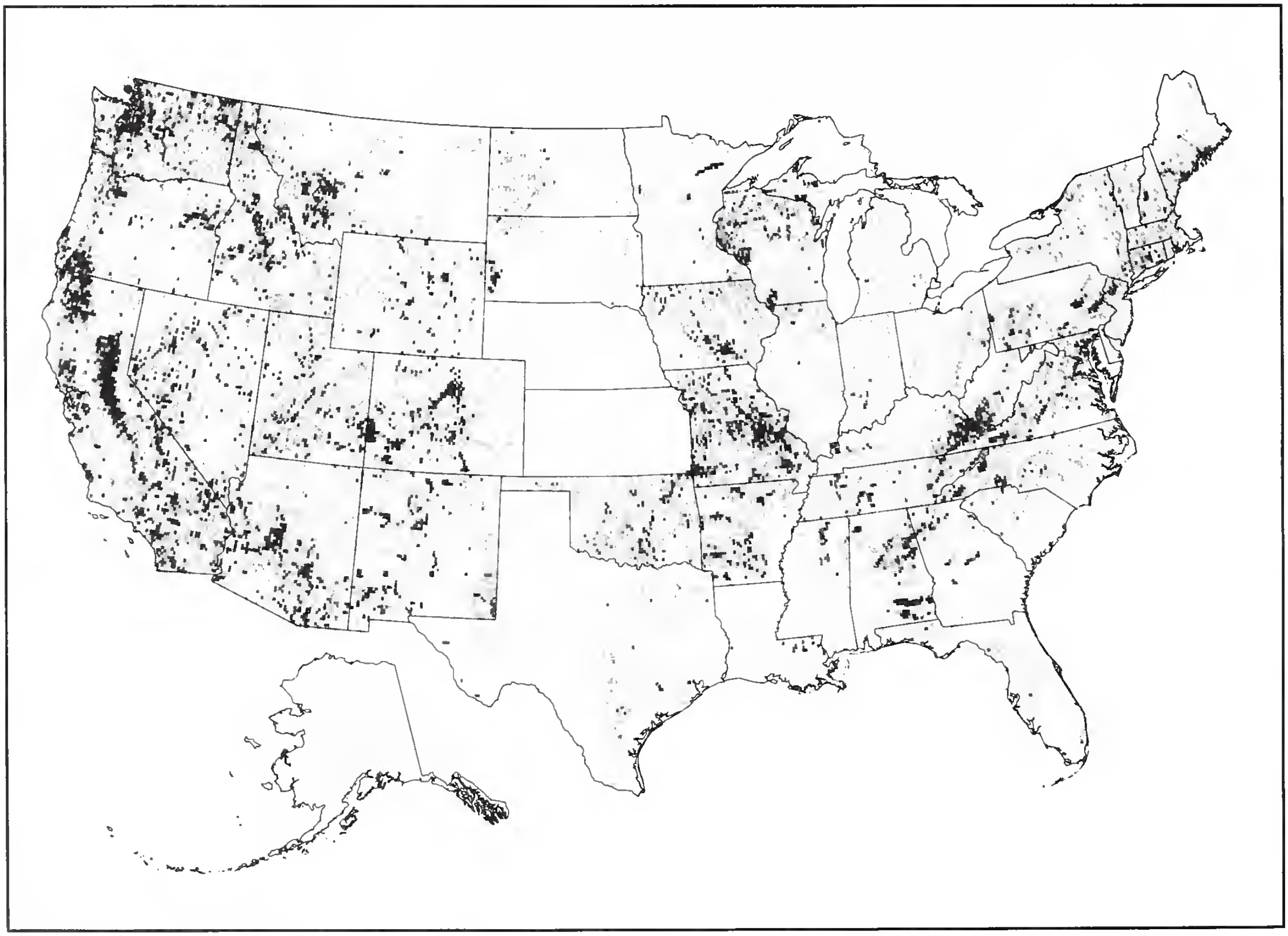
Abandoned and inactive mines on NFS lands

by Deborah Shields and
Rick Fletcher
Rocky Mountain Station

Mining in the United States is filled with a very interesting and colorful history, including the dreams of "striking-it-rich", hair-raising tales of personal courage, hardships, and, if you were one of the fortunate ones, wealth.

Today, as we look back, the industry has left another, less desirable legacy—abandoned mines. Before the 1970's, reclamation of mine sites was not required, and, for the most part, not performed. Deborah Shields, Minerals Economist with the Rocky Mountain Station says, "Abandoned mines were simply ignored. Unreclaimed sites often detract esthetically from the landscape and pose physical hazards that can cause personal injury. Moreover, some mines, as well as mill tailings and smelter waste dumps, discharge toxic materials and sediments that degrade water quality."

Currently, responsibility for cleaning up abandoned mine sites is shared among federal and state agencies and private entities, while private landowners



Map of all mineral locations (Fig. 1).

and mine operators are responsible for safeguarding hazards on their properties.

Heightened concerns about the negative impacts of abandoned mines on environmental quality are leading federal land management agencies to clean up mine sites left by others — over which they historically had no enforceable authority. Since a significant portion of the Nation's mining has occurred on or near National Forest System (NFS) lands, the Agency now has one of the more active clean up programs in the U.S. (under authority of the Comprehensive Environmental Response, Compensation, and Liability Act—CERCLA).

Shields has helped author a report that characterizes the distribution of inactive and abandoned mines throughout the millions of acres of NFS lands in the U.S. The assessment is based on the Mineral Availability System/Mineral Industry Location System (MAS/MILS)2 database, compiled by the former Bureau of Mines, USDI (now part of the U.S. Geological Survey).

MAS/MILS defined

Shields says that MAS/MILS was established to provide comprehensive information for known mining operations, mineral deposits/occurrences, and processing plants. "The non-proprietary information of the database is available to the general public and is referred to as the MAS Non-Proprietary (MAS/MILS) database. It is comprised of several data tables", she explains. The report focuses on two of them: MILS, and the commodity table. The MILS table consists of locational descriptive information for each mine; the commodity table focuses on commodities that are, or can be, recovered from a mineral deposit, as well as commodities that may adversely affect the recovery of other commodities from that deposit.

The original data were collected on a state-by-state basis from the mid-1970's to 1982. Since that time, data records have been corrected, enhanced or removed as additional data have become available.

Distribution of mineral locations

The MAS/MILS database for the U.S. comprises 207,242 mineral locations as of 1992 (Fig. 1). Almost half of the locations are designated as surface mines, reflecting, in part, the large number of sand, gravel and stone operations. Underground and combined surface-underground operations, which account for another 27 percent of the sites, are more typical of metallic ore mining. Placer mines account for approximately 4 percent.

Fifty-three percent of the 89,720 PAST producers were surface mines, another 37 percent were underground or combined operations, the remaining were placer. Among CURRENT producers, there is a much greater preponderance of surface operations, and fewer placer mines. These changes reflect a shift toward solution mining techniques, and away from more expensive, or perhaps more environmentally damaging, mining methods of the past.

"Another perspective on the data," says Shields, "can be gained by examining mineral location ownership and government administrative patterns." Two alternative approaches are utilized here: USBM "domain" designations, and geographic location. Domain fields represent ownership or administrative responsibility at the time the site was entered into the database. The USBM actively maintains these fields for only a few sites. This is important to keep in mind when reviewing data for minerals on public lands. Mineralized land has been, and continues to be, transferred to the private sector under the Mining Law of 1872. Many abandoned and inactive mines in the western U.S. can be found on claims that were taken to patent in the late 1800's and early 1900's. Often these claims lie within what are now the contiguous boundaries of NFS, BLM or other federal lands. To provide an estimate of the magnitude of the potential problems active, abandoned and inactive mines pose for the Forest Service and other federal

agencies, the data were organized according to geographic location.

Commodities

The USBM database identifies 89 commodities that may occur singly or in combination at mineral locations. "With very few exceptions, these are, or potentially could be, 'economic' commodities," says Shields. "The approach to commodity designation has important implications for analysis of the relationship between mines and water quality. Polymetallic ores have been extracted and processed to retrieve one or several elements considered at the time to be highly valuable. Any other elements, or those of too low a grade to be commercially extracted, would have ended up in the waste material—a possible source of pollution," she says.

Although the commodity designations in the database may or may not indicate current activity, they do provide information about the distribution of economic mineral deposits and the relative magnitude of activity for various minerals.

Some conclusions

Shields and co-authors note that this survey has, of necessity, been general in its analysis, and some coverage is incomplete. However, it is the largest single collection of this type of data available in an automated information system. "Efforts are continuing to standardize definitions and share information," she says.

Perhaps the most striking conclusion from this report is the widespread nature of the issue. Mining has taken place in virtually every part of the U.S. Not all of these mines are problems, especially since the mining industry began reclamation efforts. However, there are thousands that date from the turn of the Century that are still a concern.

For more information, the USDI Mine Safety and Health Administration maintains excellent records on active mines, including coal mines. The National Inventory of Coal Mines was started in 1977 by the USDI Office of Surface Mining. The USDI Geological Survey maintains the Mineral Resource Data System database, which contains extensive information on geology and mineralogy. Another source of information is the four-volume study on Inactive and Abandoned Noncoal Mines, available from the Western Governors' Association (Western Interstate Energy Board 1991; Interstate Mining Compact Commission 1992).

MILS and other historic Bureau of Mines data may be obtained by contacting the U.S. Geological Survey, P.O. Box 25086, Building 20, Denver Federal Center, Denver, CO 90225, 303-236-0421.

Copies of *Distribution of Abandoned and Inactive Mines on National Forest System Lands,* General Technical Report RM-260, are available from the Rocky Mountain Station. Additional information can be had by contacting Principal Mineral Economist Deborah Shields, Rocky Mountain Station, 3825 E. Mulberry, Fort Collins, CO 80524, 970-498-1888.

Western larch: flames, sunlight, and soil

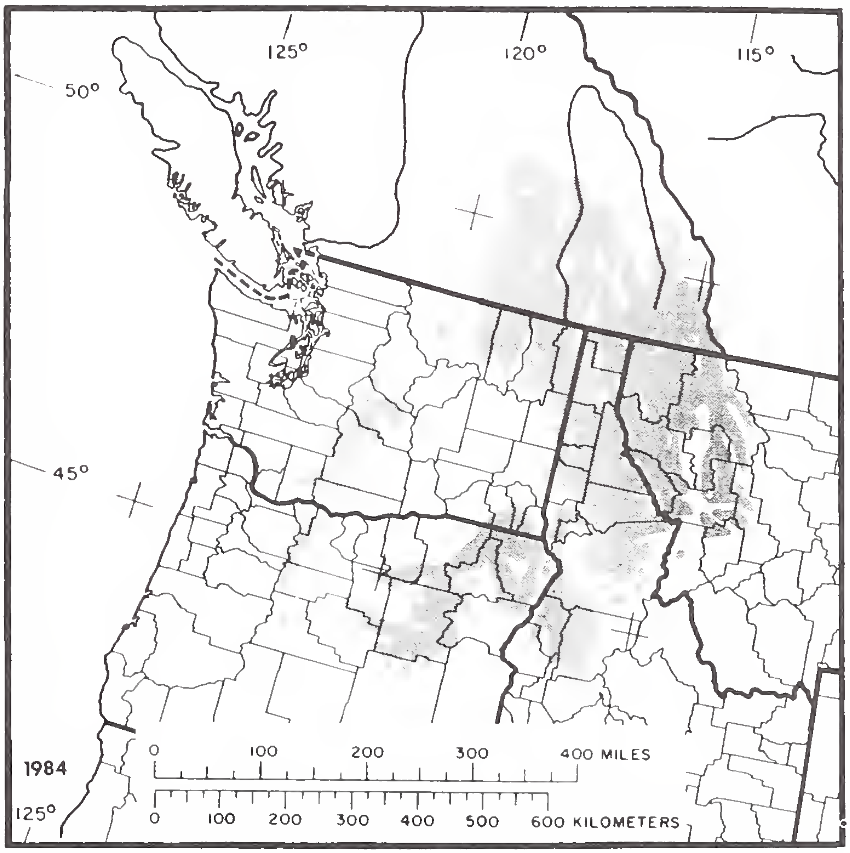
by David W. Tippets
Intermountain Research Station

Western larch, the beautiful conifer that turns yellow and drops its needles in the fall, faces an uncertain future on landscapes from Banff Park in British Columbia to the Boise National Forest in Idaho. It's uncertain future results not for lack of love, but for lack of flames, sunlight, and soil.

During the last century the modern civilization that developed in Idaho, Oregon, Washington, Montana, and British Columbia loved the larch almost to death. We cut and hauled the towering old growth to sawmills whenever we could. We cut the tall old snags to heat our homes through the cold winters. Then most damaging, for almost a century, we protected larch forests from fire—the natural ecological force critical to its survival and continued existence on the landscape. Without an ecological disturbance that allows the springtime sun to warm bare soil, forests progress through natural succession to more shade tolerant species.

Millions of visitors travel the highway across Glacier National Park and through the larch forests of the Northern Rockies. From the highway, it's hard to see the old larch stumps rotting on the forest floor where few, if any, young larch grow. Fewer people driving forest roads notice the shade-tolerant firs growing up underneath the older larch. Most casual sightseers don't observe the ladder fuels that will doom the large old trees when the next forest fire burns through the stands with their flames climbing up these ladders to larch's vulnerable green crown. Casual observers won't see the thick bark that protects larch from nature's frequent fires—fires that burn lightly across the ground and clear away the gathering debris before it creates a path for flames to run to the top of the tree. And most who drive the Going to the Sun Highway across Glacier National Park and see the young larch growing in abundance won't realize that their existence was made possible by the 1967 Huckleberry Fire.

Studying old fire-scared stumps that document the forest's history for over three centuries, forest ecologists learned that before Homo sapiens worried about air quality, or even dreamed they could control the forces of nature, forest fires molded the



Western larch extends from Banff National Park in British Columbia to the Boise National Forest in Idaho.

Research Forester Jack Schmidt installs an identification sign for Japanese larch at the International Larch Arboretum at Hungry Horse where scientists studying larch planted most of the species of larch collected from around the world.

Fire scars on ponderosa pine and western larch help forest ecologists learn the natural history of fire occurrence in the northern Rockies. Intermountain Research Station Scientist Ray Shearer points to the record of frequent low-intensity fires that created this open park-like stand of old trees that most forest visitors find attractive.

landscape of the Northern Rockies. On dry south-facing aspects, frequent low-intensity fires created an environment that produced large old-growth stands of larch and ponderosa pine. On moister cooler aspects, fire burned in smaller patches and with a wider range of severity, creating a mixed conifer forest where stands of larch mixed with Douglas-fir, Engleman spruce, and alpine and grand fir.

Fire seen by early explorers

If sightseers had crossed Montana on the southern edge of the larch's range, as did Lewis and Clark, the first tourists to travel Big Sky Country in 1805, they would have witnessed fires started by the native people. If they had crossed through Northern Idaho and Montana with the explorer Mullen in 1859, looking for a railroad route, they would have seen several fires of unknown causes. In fact, Intermountain Research Station retired biologist George Gruell documented 54 references to fire in the journals of early Montana explorers.

If today's sightseer explorers follow the path of Montana State Highway 83 from the Flathead Valley south to the Blackfoot River, they travel a worn Indian trail that often passed through groves of giant ancient larch. If they know where to look, they can see Indian campsites where frequent fires had radiated out clearing away the brush. A nearby archeological dig reveals that native people lived in the area for 3,500 years. In the Girard Grove where a few monarchs still survive, the history of fire is burned into the annual growth rings for fire ecologists to study.

Canadian explorer and geographer David Thompson provides the best written

description of what produced frequent fires in the Girard Grove and other places where the Indians frequently camped. On July 25, 1807, Thompson recorded his concern that a fire set by the Kootenai Indians to improve the land for game was rapidly approaching his Kootenai House trading post. In April, 1808 Thompson and his men descended the Kootenai River to establish the first overland fur trade route across the Continental Divide to the Columbia River. Already suffering from hunger, Thompson and his men lit fires in the dry grass wherever they could. He explained in his journal that they followed the practice used by Indians to make the area more attractive to wild game that would provide them food at the second trading post they planned to establish down river.

Thompson recorded on April 30, 1808, that they floated from the grassland into a forest and camped that evening in a stand of timber with a larch tree 13 feet around that was free of limbs for its first 150 feet of height. That this larch survived fire to reach such a large size suggests that fire was frequent enough and low intensity enough to encourage the growth of large larch along Kootenai River, as can now be observed in the Girard Grove. .

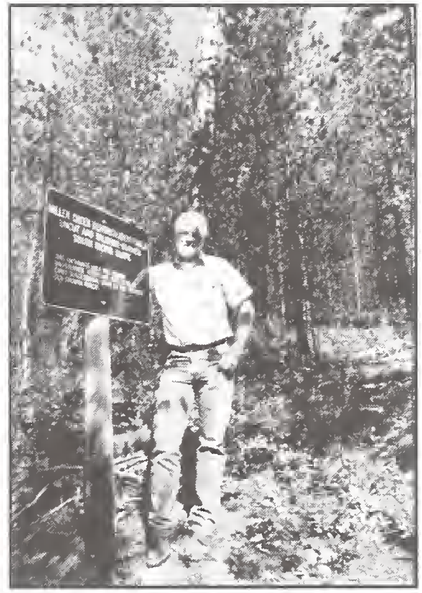
When Teddy Roosevelt arrived among the Kootenai Indians in 1886, he documented that they were still lighting fires to improve the land for wildlife, as they had been when David Thompson observed the practice decades earlier.

"Their fires, like the Indians themselves, simply merged into the landscape," wrote Professor of American Studies Stephen J. Pyne, in a paper presented at the Symposium on Wilderness and Park Management, held in Missoula in March of 1993." They were part of the natural order, nothing less and nothing more."

The insights of Thompson's journal, combined with modern research into fire ecology, show that humans have been part of an ecosystem disturbance process for centuries. Humans and their fires are an integral part of, and not separate from, the ecosystem.

Ecological demonstration

Yet, in the short-sighted wisdom with which we began this century, we sought to eliminate the force of nature that improves the land for wildlife and makes sure western larch continue to thrive in the future. When fire or another disturbance sets plant succession back to where sunlight falls on bare soil, it makes a better world for many kinds of wildlife. Almost 30 years ago, while scientists were studying the forests in Miller Creek on the Flathead National Forest, a wildfire driven by strong winds cut a swath across the drainage.



At the Miller Creek Demonstration Forest, Flathead Forest Silviculturist Jim VanDenburg shows a site where lodgepole pine, rather than larch, dominated early succession. VanDenburg states that while it's easy to grow trees on the Flathead National Forest, it's not always easy to regenerate larch forests where they one grew.

Because the fire and experimental cutting created hundreds of acres of redstem ceanothus and willow, Miller Creek now has the highest density of moose of any place in the lower 48 States. Scientists learned so much in the years that followed the fire that Miller Creek is now dedicated as an ecological demonstration area.

In the Girard Grove the ancient trees record no fires after 1860, when the influence of European's started to change native people's

use of their land. The second smallpox epidemic hit the Salish tribe in 1886 and significantly reduced their population. Their seasonal migrations were disrupted. Their routes and campsites changed to accommodate the intrusion of the whites.

Before their traditional use of the land changed, Native Americans contributed to the frequent low-intensity fires that helped shape the landscape.

"Fires burned with a crazy-quilt pattern," Intermountain Research Station fire ecologist Steve Arno, said, describing the historical mixed severity fire regime that's typical of cooler aspects in the Northern Rockies during most years.

During more rare and unusually dry summers when the forests are very flammable, such as occurred in 1988 when the Red Bench fire burned, stand-replacing fires can burn large areas, resulting in more uniform-aged stands of larch covering larger areas. Large stand replacement fires occurred before white settlement and will sometime continue to occur even with attempts to stop them. However, Arno's research reveals that low-intensity fires were once much more common.

It's comparatively easy for foresters to emulate nature's large severe fires that regenerate larch by clearcutting and burning the logging slash. That kind of forest management prepares a seedbed for larch, and lets maximum sunlight in that favors larch regeneration and growth.

Stand replacement fires

Pioneer fire scientist Harry T. Gisborne recorded for "The Frontier" magazine an account of such a stand replacement fire in 1929, called the Half Moon Burn. As Gisborne watched from Desert Mountain lookout, in what is now the Coram Experimental Forest, the fire consumed over 1,300 acres in less than two minutes. He describes an event that was breathtakingly beautiful, and at the same time terrifyingly powerful.

"The suction of this rising mass of heat drew the air across our ridge with a velocity that bounced me up against the lookout house as I stood there gaping," Gisborne wrote." This clean, cold, and therefore heavy air literally tore across the ridge and down the eastern slope to remedy the vacuum and to ignite the waiting torches. Like a mile wide and crystal clear wedge, it drove under the solid whirl of superlatively hot smoke and lifted it fifty or sixty feet, so that we could again see the entire slope from ridge top to creek bottom. As the oxygen in this fresh air reached the trees, brush, windfalls, and grass, which had been super-heated by the big

From the overlook in the Coram Experimental Forest you can see the landscape mosaic created by scientists studying the results of different harvest methods. Early in the Experimental Forest's history scientists learned that exposing mineral soil for a seedbed and getting full sunlight to the ground are essential for the regeneration of larch forests.

whirls, everything burst into flame at once."

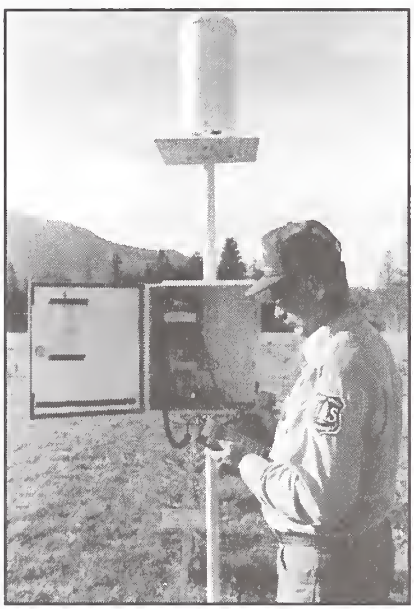
Gisborne's description of the "blow-up" leaves little doubt that the natural force of nature that would regenerate thousands of acres of larch forest in a single ecological event is far too dangerous to fit today's modern forest management needs. To even attempt to imitate that level of natural disturbance with logging and slash burning is socially unacceptable in the forest where small towns and homes now dot the landscape. The ecosystem disturbance processes left to foresters to imitate, are the more moderate ones, such as the fires that occur during more typical fire seasons and the fires Indians lit.

Emulate crazy quilt

It's much harder for foresters to emulate the diverse crazy-quilt pattern described by Arno, and successfully get larch to grow back on the site. If the seedbed of mineral soil isn't adequately exposed and there isn't enough sunlight, more shade tolerant trees will replace larch.

Perhaps it is natural for many people to want logging practices to disturb the forest and its beauty as little as possible. If foresters serve that desire by prescribing the kinds of timber sales that just carefully remove a few old trees, they provide health care for only the overstory of the forest, and not the understory. Without treating the understory the way nature treated it historically with fire, larch is doomed. Nature's cure for forest health is to treat the whole forest and not just one of its parts.

"Larch is one species we can mess up and lose," says Flathead forest silviculturist Jim Vandenburg, explaining that, while it's easy to grow trees in northwestern Montana, it's not always easy to grow larch. As



Intermountain Research Station Forester Jack Schmidt downloads weather data at the Coram Experimental Forest where scientists have monitored the relationship between climate and larch regeneration and growth for 50 years.

Fire Ecologist Steve Arno looks at the Stump of an ancient western larch in the Girard Grove near Seely Lake, Montana. From examining fire scars in this stand, Arno learned the history of fire in the stand's understory that extended back in time for over three centuries.

head silviculturist, it's Jim's job to not only make sure trees grow back after logging, but to implement what's now referred to as ecosystem management.

Evolving from more traditional forestry to ecosystem management means that foresters are placing more balanced emphasis on the nontimber parts of the ecosystem. The stabilization of soil and the production of clean water are emphasized more than the production of logs. The goal of ecosystem management is to maintain the health of forests' future. Managing wildlife habitat to conserve rare species, such as the grizzly and other forest carnivores, is also an important part of implementing ecosystem management.

Because ecosystems are so complex and there are so many things that natural resource managers still don't understand, foresters work closely with scientists from the Forest Service's Intermountain Research Station at the Miller Creek Demonstration Forest, and in the nearby Coram Experimental Forest. Fifty years of probing into the larch forest ecosystem at Coram have made the Flathead area an international center of scientific knowledge about larch.

Whitefish, MT, was a natural location for an international symposium on the ecology and management of larch forests held in 1992. Almost 350 scientists from 17 countries assembled to share state-of-the-art knowledge about larch forests. The Intermountain Station recently published the proceedings of that symposium, entitled *Ecology and Management of Larix Forests: A Look Ahead*, General Technical Report INT-319, a 521-page volume that puts under one cover much of what's known about larch tree species around the world.

On the occasion of the symposium, participants gathered at Hungry Horse to dedicate the International Larch Arboretum. Most of the known larch species are planted there, including seven Eurasian species. Having all the species represented there provides scientists with future opportunities to explore hybridizations that may offer important adaptations to frost damage and other environmental limitations to larch regeneration and growth.

Scientist Ray Shearer, one of the world's experts on the ecology and management of larch forests, shows where a black bear pealed the bark from a young larch in the spring to eat the sugar laden sap, named "arabinogalactan." Although superior in their resistance to insects and disease, the larch at Coram have an unusually high mortality caused by black bears.

Station scientists have already begun hybridization experiments between western and alpine larch, the two naturally occurring species in the Northern Rockies. Foresters from Iceland, Germany, and Switzerland have already shown interest in the hybrid for its potential to produce seedlings that can better survive freezing. Other hybrids show promise in increasing resistance to insects and disease.

While insects and disease have caused catastrophic mortality in pine, fir, and spruce forests, mature western larch forests have proven more resistent to the pests. Larch's ability to survive the attacks of these natural enemies motivate scientists and foresters to learn how to maximize the range of the tree's distribution to the south, on drier sites, and higher elevations. In some cases it may be just restoring the tree to areas where it used to thrive, and in other cases it may be learning how to manage the genus to thrive in areas where it never has before. Many believe that keeping more forest acres in larch will reduce

the forest health problem that creates both economic losses and increases the danger of catastrophic wildfires.

Conserving larch forests promises society healthy forests with a sustained flow of high value timber and firewood. Larch forests provide unsurpassed forest beauty. They make possible the opportunity to manage for low intensity understory fires that can be suppressed to protect the increasing number of homes springing up on the urban-wildland interface.

Those desirable future conditions would be easy to accomplish with only the first major scientific lessons learned at the Coram Experimental Forest—if we were managing for a future without human values. The first lessons for growing larch were simply described with three words: flames, sunlight, and soil. Clearcutting and severe wildfires both bare the soil and allow full sunlight to reach the forest floor. But when we add people who want scenery with clear blue skies and big trees, and forests full of grizzly, and warm homes made of wood, we complicate management; we do not have enough ecological insight.

Foresters will seek to emulate the ecological processes and conditions of the multiseverity fire regime that was typical during average fire seasons before human fire suppression altered the ecosystem. The ecosystem management that maintains larch on the landscape will have a human dimension, as nature included with the native people who set fires for centuries before we tried to eliminate it in modern times. The science of ecosystem management will include archeologist, anthropologists, sociologists, and historians to help us see how people fit into the landscape.

Scientists and natural resource managers will work together at Miller Creek and the Coram. Ecosystem management will be a continual process of science and management collaboration.

Research at Coram showed that some silvicultural treatments besides clearcutting can succeed in regenerating larch. Still, questions remain. How big do openings need to be to let adequate sunlight in for larch seedlings? How do foresters expose enough mineral soil to prepare a seedbed for larch seeds and still keep enough organic matter on the forest floor to preserve the health and productive potential of forest soil? What does the "crazy quilt" pattern do to wildlife populations?

Natural resource managers and scientists will travel the ecosystem management path together, continually making course corrections as insights are gained into complex functions and processes of the forest. As they do, the relationship of human beings to flames, sunlight, and soil remains part of the equation.

New from research

Owls of old forests of the world

To better understand the broader context of conservation strategies developed for the Northern Spotted Owl in the Pacific Northwest of the United States, this paper reviews the status and management of owls associated with old, closed-canopy, or undisturbed temperate and tropical forests throughout the world.

No scientific studies have demonstrated to date that forestry can be used to restore old-forest habitats and associated owl populations. In the Pacific Northwest, however, silviculture studies are underway to test how well old-forest components, such as large live trees, large snags and down logs, and dense and diverse vegetation structures, can be maintained intentionally or induced by direct stand manipulation. One phase of these studies involves testing behavioral and population responses by the Northern Spotted Owl in National Forests. Restoration projects elsewhere, as in Costa Rica and India, might help identify useful silvicultural methods to recover local populations and habitats of old-forest owls, but much work still is needed.

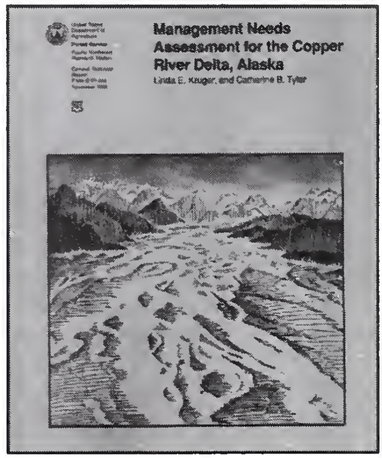
Request *Owls of Old Forests of the World*, General Technical Report PNW-343, from the Pacific Northwest Research Station.

Management needs for the Copper River Delta, Alaska

This report assesses needs, problems, and perceptions relevant to management of the Copper River Delta (Alaska)—the largest coastal wetland along the Pacific coast of North America. The assessment provides a basis for planning and decision-making and a framework for ongoing research, development, and application. It also underscores concerns about human impacts and supports the need for a greater understanding of the interrelations among resources and resource uses, and between resources and people.

The Copper River system, located in south-central Alaska, encompasses the Copper River Delta and the river basin.

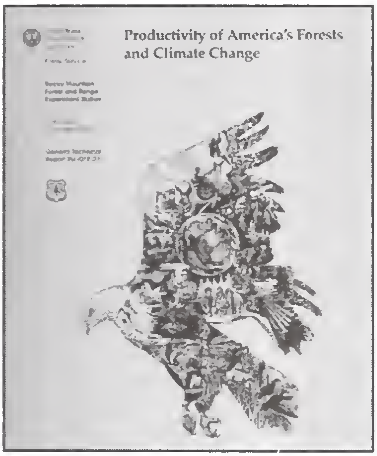
Request *Management Needs Assessment for the Copper River Delta, Alaska*, General Technical Report PNW-356, from the Pacific Northwest Research Station.



America's forests and climate change

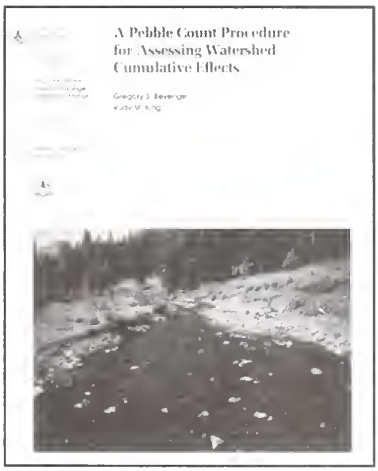
A new Resources Planning Act publication assesses the impact of climatic change on the forestry sector and carbon storage on timberlands. The report details the effects of climate change on various regions of the U.S. Timber

prices, imports and production are also covered. For your copy of *Productivity of America's Forests and Climate Change*, General Technical Report RM-271, contact the Rocky Mountain Station.



Counting pebbles

Land management activities can result in the delivery of fine sediment to streams, and, over time, lead to cumulative impacts to aquatic ecosystems. Because numerous laws require federal land managers to analyze watershed cumulative effects, the Forest Service has developed monitoring procedures that can be used directly and consistently. A new report, titled *A Pebble Count Procedure for Assessing Watershed Cumulative Effects*, is now available from the Rocky Mountain Station that describes the approach. It involves sampling a longitudinal reach of stream channel several hundred feet long, using a zig-zag procedure that crosses all habitat features within a stream channel. Case studies are presented. Copies of Research Paper RM-319 are available from the Rocky Mountain Station.

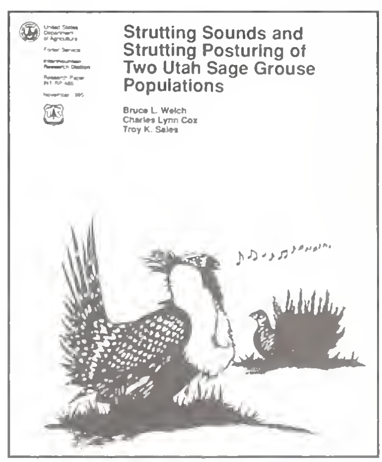


Sage grouse courtship behaviors compared

Provo Shrub Lab scientist Bruce Welch worked with Brigham Young University audio specialists Charles Cox and Troy Sales to record and analyze the sounds and postures of two sage grouse populations during courtship. They learned that the two populations sang the same love songs and danced the same romantic dances. They concluded that courtship behavior alone should not preclude augmenting the population in jeopard with members of the population not threatened.

The researchers used sound and video tape recordings to record the behavior, then analyzed it with Pro Tools software on a Macintosh Quadra 950 computer. The analysis revealed 16 elements in the strutting sequence—twice the number previously detected with sonagrams. In comparing the elements between the two populations they learned that birds take the same number of steps in their strutting sequence.

Request *Strutting Sounds and Strutting Posturing of Two Utah Sage Grouse Populations*, Research Paper INT-485, from the Intermountain Research Station.

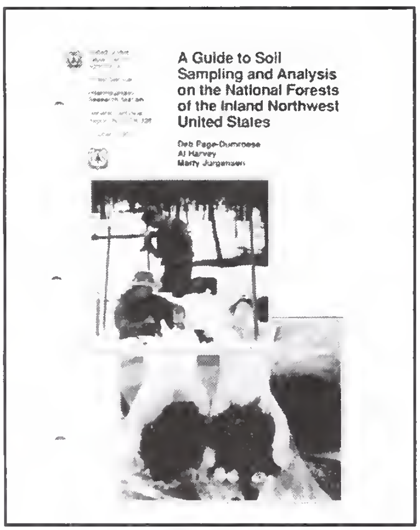


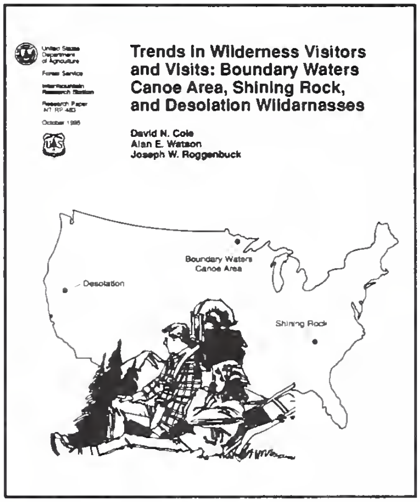
Guide to soil sampling

Soil samples tell us about biological productivity, fire history, global warming, and relative nutrient content. This guide gives field crews information on how to best collect samples, analyze the samples, and translate the data.

The 16-page publication focuses on working with the typical Andisol soils found in the National Forests of the Inland Northwest. It is especially valuable in alerting people to special problems and cautions needed to get good data from samples of these particular kinds of common forest soils.

Request *A Guide to Soil Sampling and Analysis on the National Forests of the Inland Northwest United States*, General Technical Report INT-326, from the Intermountain Research Station.





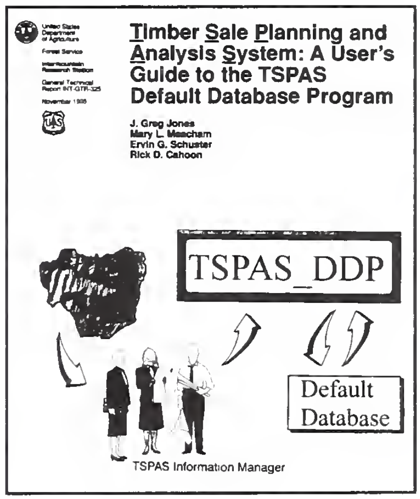
Trends in wilderness use

Scientists replicated previous studies on wilderness visitors and the nature of the visits to determine trends in three widely separated wildernesses. They learned that changes in wilderness use and users are not nearly as significant over the last two decades as some have suggested.

Aldo Leopold Wilderness Research Institute Research Biologist David Cole and Social Scientist Alan Watson worked with Forest Recreation Professor Joseph Roggenbuck of Virginia Polytechnic and State University to study trends in the Desolation Wilderness in California, the Boundary Waters Canoe Area in Minnesota, and the Shining Rock Wilderness in North Carolina. They detected only subtle changes in the types of people who visit wilderness and the nature of their trips.

"Managers should be skeptical of the broad generalizations about wilderness visitor trends," the authors recommend.

Request *Trends in Wilderness Visitors and Visits: Boundary Waters Canoe Area, Shining Rock and Desolation Wildernesses,* Research Paper INT-RP-483, from the Intermountain Research Station.



TSPAS computer program for planning timber sales

Researchers with the Economics Research Work Unit at the Missoula Forestry Sciences

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3) *Timber Sale Planning and Analysis System: A User's Guide to the TSPAS Default Database Program*, General Technical Report INT-325, and *Timber Sale Planning and Analysis System: A User's Guide to the TSPAS Sale Program*, General Technical Report INT-321

4) *A Guide to Soil Sampling and Analysis on the National Forests of the Inland Northwest United States*, General Technical Report INT-326

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Laboratory created two interrelated programs to assist planners in designing and evaluating timber sale alternatives called the Timber Sale Planning and Analysis System (TSPAS).

The sale program is referred to as TSPAS SP and the default data base program as TSPAS DDP. Using the software on the Forest Service's in-house computer system timber planners can predict if a given alternative will sell, what the K-V costs and benefits will be, and a variety of other things important to timber planning.

Request *Timber Sale Planning and Analysis System: A user's Guide to the TSPAS Default Database Program,* General Technical Report INT-325, and *Timber Sale Planning and Analysis System: A User's Guide to the TSPAS Sale Program*, General Technical Report INT-321, from the Intermountain Research Station.

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